

A.6.1

DESIGN OBJECTIVES/REQUIREMENTS APPROVAL

COMPANY PRIVATE

(Jan. 14, 1974)

\* [ ] # ARI1061

REV. # 01

DESIGN 

* OBJECTIVES	REQUIREMENTS
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 FOR: Software Writer's Language (SWL)

(\* - STRIKE OUT TERM THAT DOES NOT APPLY)

SIGNATURES - DEVELOPING COMPANY	DATE
PREPARED BY: <i>5746-100</i>	12/18/73
REVIEWED BY: PROJECT MANAGER	
COMPANY APPROVAL: VICE PRESIDENT (COMPANY DELEGATE)	

RESPONSE TO REVIEW DISTRIBUTION

SYSTEMS AND SERVICES COMPANY  
PERIPHERAL PRODUCTS COMPANY  
MARKETING COMPANY  
PRODUCT & SERVICES STRATEGY  
CORPORATE ENG. & SFTWE.  
CORPORATE MANF., MATL., & QA

RESPONSE

APPROVED: \_\_\_\_\_

VICE PRESIDENT DATE  
(COMPANY DELEGATE)

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DOCUMENT		SECTION		THIS	REPLACES
SWL Design Objectives				FILE	Revision 1
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## 1.0 DEFINITION

This Design Objective covers the set of projects required to design and implement a Software Writers Language (SWL) and develop and provide training in the language and its use. The projects will produce a language specification, a compiler having the capability to generate code for three distinct target machines, and modifications to a PASCAL compiler for the CDC 6000 to permit it to process a compatible subset of the SWL language.

The modified PASCAL compiler will be called ISWL for Interim SWL and will be scrapped as soon as the SWL compiler becomes operational.

The training material and courses will be developed and made available to CSEI for continued offering.

## 2.0 REFERENCES

### 2.1 Planning References

1. "Concepts and Organizational Plans for the Joint Design and Implementation Control of an Integrated Family of Computer Systems", a controlled distribution confidential report to the NCR-CDC Steering Committee, Revision dated August 6, 1973.
2. Software Writer's Language Task Group Final Report dated April 18, 1973.
3. IPL Requirements and Goals; a document in preparation.
4. Memo: R. M. Price to Distribution, dated November 1, 1973, Subject: Implementation Languages.
5. Software Engineering Technical Strategy; Draft 2, Undated by R. E. Morris.

### 2.2 Interdependent DO and DR Documents

1. IPL Operating System; to be produced.
2. Software Engineering System; to be produced.

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### 2.3 Technical References

1. The Programming Language PASCAL {Revised Report}, N. Wirth.

### 2.4 Standards

#### 2.4.1 NCR/CDC Standards for IPL; to be developed.

These standards are expected to meet the intent of the following CDC Standards:

1. CDC-STD 1.50.001, Hardware and Software Product Support Manual Standards.
2. CDC-STD 1.55.001, Product Support Manual Format and Style Guide.

#### 2.4.2 Industry Standards

1. American National Standard Code for Information Interchange, X3.4-1968.

## 3.0 OBJECTIVES

### 3.1 Functional Objectives

1. To design and develop a language and compiler(s) which will meet the need of software development projects for the NCR/CDC Integrated Product Line.
2. To develop courses and materials to train experienced high level language programmers and experienced assembly level language programmers in the SWL language and its use. This includes training in programming methods.
3. The software to be developed using SWL includes Operating System, Compilers and Utility programs but does not include applications programs.
4. The language and compilers will be focused to support the IPL development program. To the extent that this objective is not compromised, the language and compilers will also accommodate current product software of either NCR or CDC.

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5. The compilers will operate in the Software Engineering System environment.
6. Capability to generate code for the CYBER-70 based Software Engineering System from a subset of the SML language is required at the earliest possible time.
7. The SML definition will be based on the PASCAL language and compiler as running on the CDC-6000 in July 1973.

### 3.2 Performance Objectives

The compilation speed objective will be to process no less than 1000 source lines per minute on a CYBER 70/73 or equivalent processor.

The compilation will require no more than 500KB to contain program and tables for compilation of an average size program. In a virtual memory environment, the compiler will take advantage of the VM mechanism to fit in available memory. When available memory is less than the object limit, compilation speed will decrease in a non-linear fashion.

Reliability of the compiler will be such that six months after release in heavy use, no source language construct will be able to cause the compiler to abort. By that same point in time, the expected rate of discovery of unique errors in generated code due to incorrect operation of the compiler will be less than one in  $10^5$  source statements.

### 3.3 Compatibility Objectives

The language must be similar to PASCAL, but changes required to accommodate IPL architecture or to improve the language as a development tool are to be preferred over compatibility with PASCAL.

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## Attachment A:

In lieu of a Project Authorization, the following summary of costs is submitted. Individual projects will submit PA's and approval for each PA will be done at the time of submission.

This cost summary covers projects which have been underway since early 1973 through projects which will extend to approximately 1978.

<u>Project No.</u>	<u>Activity</u>	<u>\$000</u>
R3*SL4	ISWL Development {Incl. previous effort} {A}	352
"	SWL Training Development {A}	113
	SWL Development	
6501500	Compiler Design {A}	110
	Front End	332
	P0/01 Code Generator	400
	P2-P4 Code Generator	425
	SES Code Generator	105
	SWL Product Test	85
	Total	1922

The estimates marked {A} are based on project plans and are within the tolerance of project planning techniques. The remainder of the estimates are based on anticipated project sizing but have not had detailed work/time estimates made. These should be taken as  $\pm 20\%$  estimates.

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## Attachment B:

The following 31 pages extracted from the SWL Work Statement show the documents to be produced by each of the projects.

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## SOFTWARE WRITERS LANGUAGE (SWL)

PURPOSE: This statement is intended to provide overall direction for the projects required to provide a Software Writers Language facility for the development of the IPL. The statement also provides for training in the language and the facilities and use of SWL.

SCOPE: Two distinct efforts are envisioned. One is to make modifications to the PASCAL compiler currently available and running on the CDC CYBER 70. This is referred to as ISWL in this statement. The second is the work required to produce a SWL system to meet the 5 to 10 year needs of the IPL development and support. This is referred to as SWL in this statement. Although these efforts are seen as distinct, they are closely related and must be closely coordinated.

For purposes of description, the efforts are divided into three projects.

ASSUMPTIONS: The assumptions on which this statement is based are:

1. The IPL Software Engineering System (SES) will provide the IPL system environment which will be used for the development of the IPL software. Initially, this environment will be available on CYBER 70 and will rely on KRCMOS for a software base. A simulated IPL interface (hardware and/or software) will first be provided on CYBER 70 to allow SWL source code compilation and CYBER 70 like object code execution. As the SES evolves in later phases, when true IPL object code is generated, this interface will be preserved for the simulation, emulation or actual execution on IPL system hardware IPL object programs.

SES will embody a consistent set of development tools for the design implementation and checkout of IPL system software. This includes the following:

- a) Text Editing: An interactive text editing capability to allow the creation, formatting, editing, and output generation of IPL documentation.
- b) Source Code Maintenance: The ability to create, maintain and control source program files with imbedded documentation from interactive terminals.
- c) Debugging Aids: An interactive capability to symbolically debug program and data elements without specially imbedded source language statements. This ability will be available for both interim and final SWL.

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- d) Simulation: Initial simulation of the IPL environment on CYBER 70 will be provided. Actual CPU simulation will be provided later and will maintain the interface to the IPL environment.
- e) SES Support Utilities: A series of utility routines necessary for support of SES facilities will be developed. This includes things such as small conversion programs, file utilities, format utilities, reporting programs, etc.

2. The structure of the SWL compiler will be as shown in Figure 1.
3. ISWL will be a compatible subset of SWL.
4. ISWL will be achieved by modification of the PASCAL compiler now running on the CYBER 70. ISWL will not be compatible with PASCAL due to changes in the language required to accommodate the needs of IPL. Of these, the change from display code to ASCII character set and collating sequence is fundamental.
5. The only justification for ISWL is as an interim facility to SWL and therefore effort should be put into SWL rather than additional embellishment of ISWL.
6. This plan is intended to meet the needs of the IPL development as its major thrust. The language and SWL compiler design will provide for code generators to be built for the Century II, CYBER 70 and MP17 computers. The design will also provide for compilers to be implemented on Century II and CYBER 70 by cross compiling.
7. The language definition for SWL will be under the strict control of ASL regardless of who implements a compiler to process that language.

ORGANIZATION: The responsibility for direction of the activities under this statement is assigned to the ASL-Western Laboratory. This statement allocates the work into projects and assigns project management responsibility at that level.

To provide a mechanism for consideration of suggested changes to the SWL language definition and assure control of the language, a SWL Control Board is established by this statement. This board will accept suggestions for changes to the SWL when accompanied by justification judged adequate by the board. These suggestions will be considered

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and approved or rejected based on their merit and justification. The Chairman of the Risk Control Board is T. H. Elrod. The members are J. W. Smith and J. W. Horner of NCR and R. A. Peterson, C. W. Schwarz and L. R. Kerr of CSC. The board will meet as required to consider proposed changes, but in any case once every three months.

The structure of the projects in this statement is shown in Figure 2 and assignment of project responsibilities is shown in the matrix of Figure 3.

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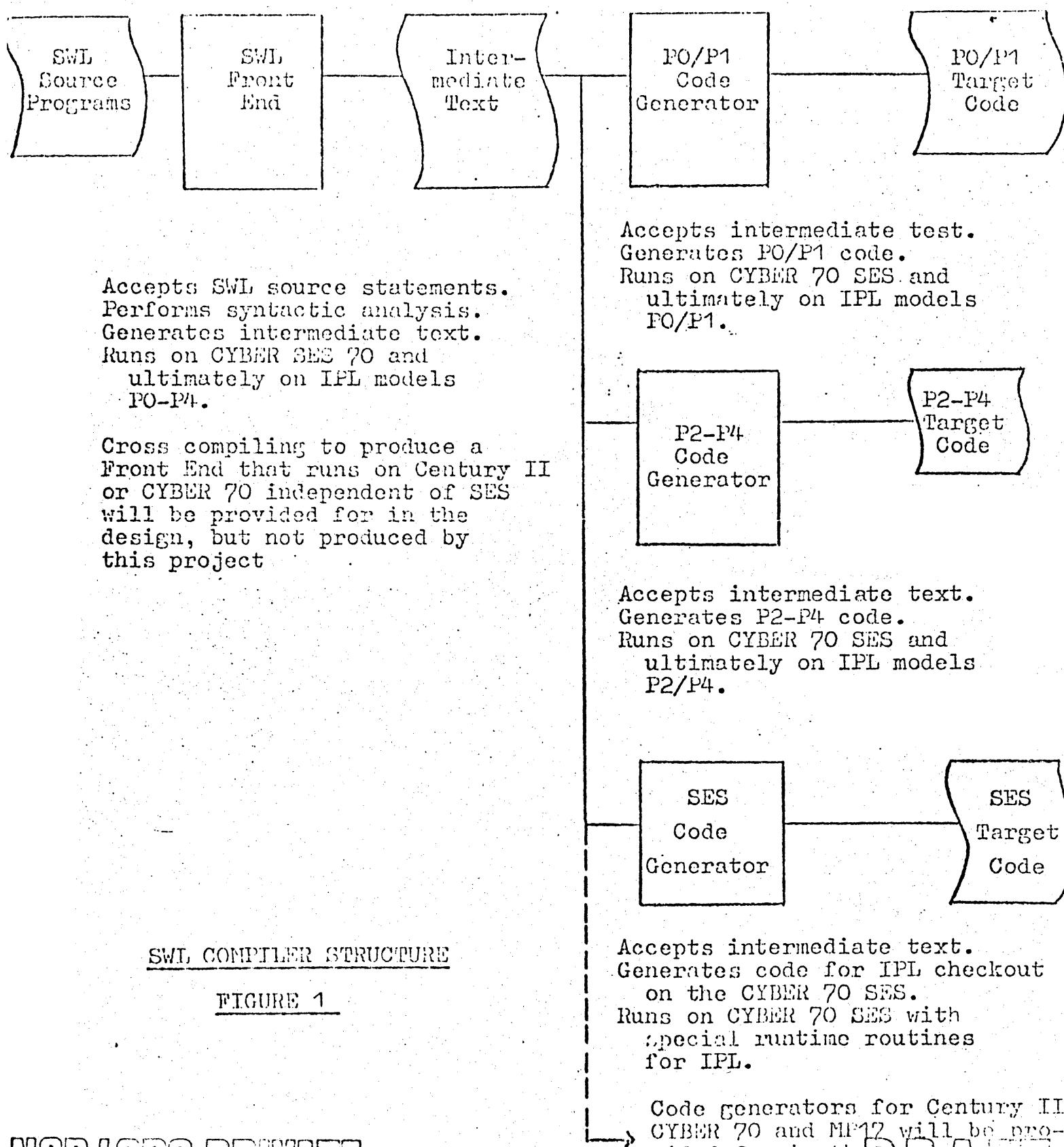
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## ANTIQUES

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## SWI COMPILER STRUCTURE

### FIGURE 1

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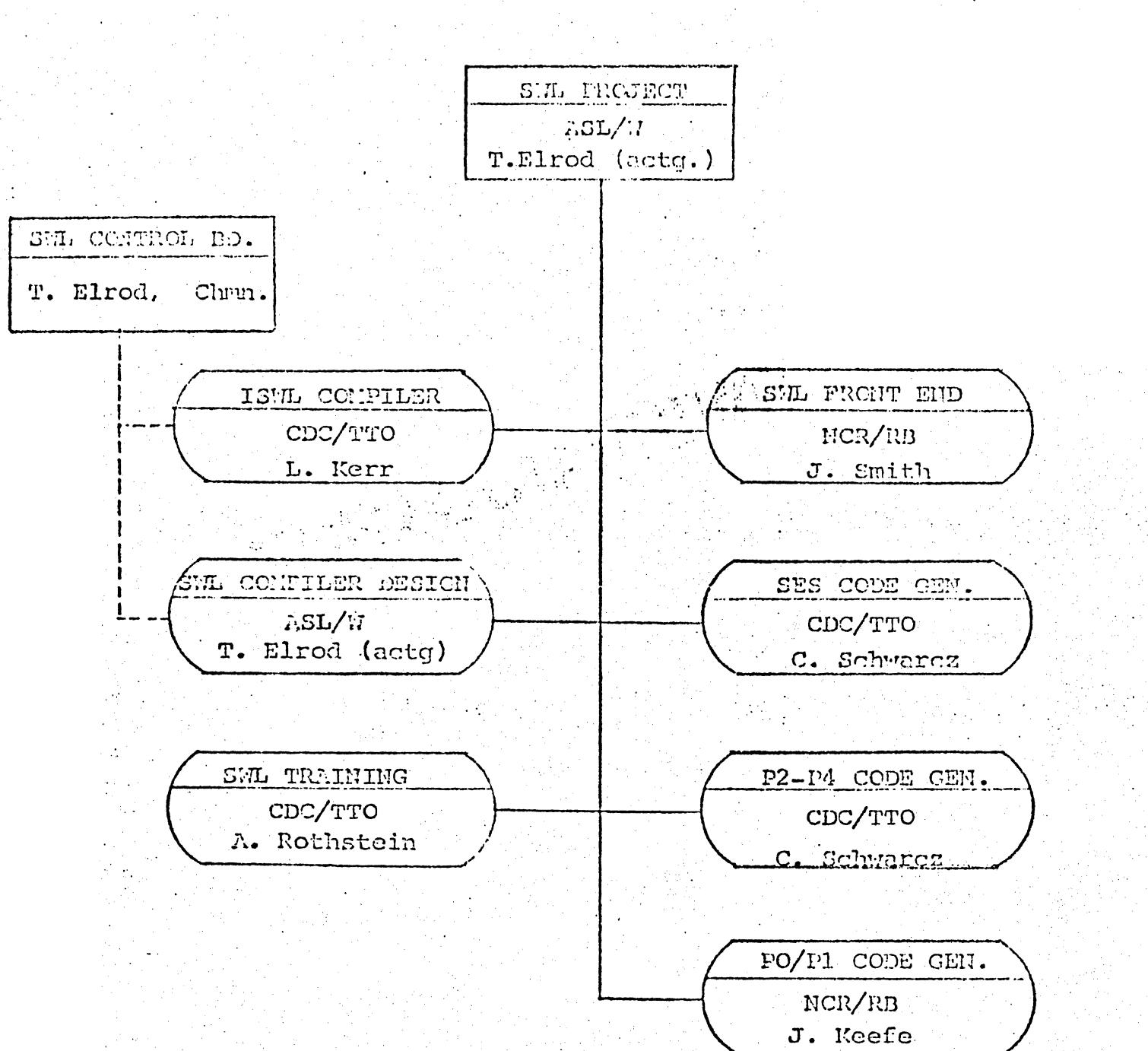


FIGURE 2

## SWL PROJECT ORGANIZATION

## ADVANCED SYSTEMS LABORATORY

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SWL WORK STATEMENT  
RESPONSIBILITY MATRIX

CDC/TTO      NCR/RB      ASL-W      ASL-C

Overall Project Management

Language Control	x
Design Document Approval	x
Budget Approval	x
Phase Review Approval	x

SWL Project No. 1

Project Management	x
ISWL Course Devel.	x
SWL Training Guide Dev.	x
SWL Course Devel.	x
Structured Progr. Course	
Devel.	x
SWL Users Guide	x

SWL Project No. 2

Project Management	x
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Project No. 2-1

SWL Compiler Design	x
SWL Reference Manual	x

Project No. 2-2

SWL Front End	
Design & Spec.	x
Code	x
SES Integration	x
Maintenance Support	x

Project No. 2-3

SES Code Gener.	
Design & Spec.	x
Code	x
SES Integration	x
Maintenance Support	x

Project No. 2-4

FO/FT Code Generator	
Design & Spec.	x
Code	x
SES Integration	x
Maintenance Support	x

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Figure 3

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SWL WORK STATEMENT  
RESPONSIBILITY MATRIX

CDC/PFO      NCR/RB      ASL-W      ASL-C

Project No. 2-5

F2-F4 Code Generator

Design & Spec.      x

Code      x

SES Integration      x

Maintenance Support      x

x

Project No. 2-6

Product Test (SWL)

x

Project No. 2-7

SWL Maintenance-Overall

x

SWL Project No. 3

Project Management      x

ISWL Release 1      x

ISWL Release 2      x

Integration with interim SES      x

x

Maintenance Support      x

Figure 3 (Cont'd)

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CONTRAINTS: Certain elements of this plan are dependent upon facts not yet available. These represent potential delaying or risk factors in the plan and are called out here as a matter of record. Resolution is required on the following:

- Level of ASCII support provided by SES
- SES facilities and their availability
- Definition of the text input to the IPL linker/loader
- SES linker/loader interfaces
- IPL character-set specification
- PO-P4 machine and operating system specifications
- Necessity, degree of operating system support, and flavor of SWL support, for:
  - reentrant code
  - location-independent code
  - coroutine linkages
  - recursive linkages
  - asynchronous processes
  - interlocking of shared objects
  - machine breakouts
  - different file-accessing methods
  - different data types (e.g., decimal)

Compile-time operational requirements, including configuration ranges

Object-time operation requirements, and degree(s) of optimizational required.

PROJECT MANAGEMENT: The management of the projects described in this Work Statement will be based on the documents, process and standards described in the document "Software Development Guidelines", CDC #60418500 and standards referenced therein. The specific requirements are:

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1. Design documents: The following table shows the design documents which must be produced by the Projects

Document Type	1	2	2-1	Project No.	2-2/2-5	2-6	2-7	3
Project Authorization	A	B	C		C	C	D	A
Design Objectives		B	C		C		D	
Design Plan		B	C		C	C	D	A
Preliminary External Reference Spec.		B	C		C		D	
Build-To External Reference Spec.		B	C		C		D	
General Design Specification		B	C		C		D	
Design Requirements	A	B	C		C		D	A
Implementation Plan		B	C		C		D	A
External Reference Specification		B	C		C		D	A
Internal Maintenance Specification		B			C		D	
Test Specification					A			

Key:

- A means the document applies only to that project
- B means the document is a consolidation of several project documents
- C means the document is a section to be consolidated under another project document
- D means the document will be required when changes of sufficient magnitude are to be made and revisions to existing documents will be required.

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2. External Documentation: The following table shows the external documents which must be produced by the projects.

Document Type	Project		
	No. 1	No. 2*	No. 3
	ISWL	EWL	
General Information Manual			
Reference Manual			A
Training Guide		A	
Installation Handbook			B
Training Class Materials	A	A	
Diagnostic Handbook			B
Internal Maintenance Spec.			B
Instant			
User Guide		A	

\*This includes projects 2, 2-1 through 2-7.

3. Management Checkpoints: The following table shows the checkpoints required of each project.

Checkpoint	Project		
	No. 1	No. 2*	No. 3
Project Initiation	x	x	x
Project Objectives		x	
Product Design		x	
Implementation Plan	x	x	x
Product Release	x	x	x

\*This includes projects 2, 2-1 through 2-6.

4. Technical checkpoints: The following table shows the checkpoints at which reviews will be conducted of each project by a Technical Review Board.

Checkpoint	Project		
	No. 1	No. 2*	No. 3
Completion of SWL Language Definition		x	x
Completion of BT-ERS		x	
Completion of Imp. Plan	x	x	x
Completion of ERS		x	x
Completion of TEST Spec.		x	
Completion of Trng. Class Material	x		

sets 2-2 through 2-6.

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5. Management Reports: The following table shows the reports required of each project.

Report	Project		
	No. 1	No. 2*	No. 3
Weekly Highlight	x	x	x
Monthly Progress Containing-			
Narrative status	x	x	x
Milestone analysis	x	x	x
PERT update		x	x
Problem list	x	x	x
Manpower analysis	x	x	x
Critical Item Report	x	x	x

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**Attachment C:**

The applicable standards from CDC Standard Checklist are referenced in Section 2.4 and the standards checklist is attached.

## CDC STANDARDS CHECKLIST

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\* The standard contains selectable options

Validation/Certification Needed

Waiver Approved Previously

Waiver Required

Compliance Planned

Applicable

Category - CCDS

CCS-SID 1.10.003 Control Data Subset of ASCII (Rev. C)

ANSI X3.4-1962 Code for Information Interchange X X

ANSI X3.6-1973 Perforated Tape Code for Information Interchange

ANSI X3.26-1969 Hollerith Punched Card Code

FIPS PUB 1 Code for Information Interchange

FIPS PUB 7 Implementation of the Code for Information Interchange and Related Media Standards

FIPS PUB 14 Hollerith Punched Card Code

FIPS PUB 15 \* Subsets of the Standard Code for Information Interchange

ISO R646-1973 \* 6 and 7-Bit Coded Character Sets for Information Processing Interchange

ISO R963-1969 \* Guide for the Definition of 4-Bit Character Sets Derived from the ISO 7-Bit Coded Character Set for Information Processing Interchange

ISO R1679-1970 Representation of the 7-Bit Coded Character Set on 12-Row Punched Cards

ISO R2021-1971 Representation of the 8-Bit Patterns of the Coded Character Set on 12-Row Punched Cards

ISO R2022-1973 Code Extension Techniques for Use With the ISO 7-Bit Coded Character Set

ECMA 6-1973 7-Bit Input/Output Coded Character Set

ECMA 14-1967 \* Rules for the Definition of 4-Bit Sets Derived from the ECMA 7-Bit Coded Character Set

ECMA 17-1968 Graphic Representation of the Control Characters of the ECMA 7-Bit Coded Character Set for Information Interchange

ECMA 25-1970 Representation of the 8-Bit Combinations on 12-Row Punched Cards

ECMA 35-1971 Extension of the 7-Bit Coded Character Set

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Waiver Required

Compliance Planned

Applicable

\*The standard contains selectable options

Category - ELECTRICAL DESIGN (Continued)

CDC-STD 1.30.021	Computer Grounding Theory Design Guide Handbook			
CDC-STD 1.30.022	EMI Performance Requirements and Test Methods (Rev. A)			
CDC-STD 1.30.023	Digital Computer System Grounding (Rev. A)			
CDC-STD 1.30.024	Analog Computer Systems Grounding (Proposed - not released)			
CDC-STD 1.30.025	EMI Suppression and Certification (Rev. A)			

Category - DOCUMENTATION

CDC-STD 1.01.004	Hardware Product Configurator (Rev. A)			
CDC-STD 1.01.007	Equipment Configuration Identification and Control (Rev. E)			
CDC-STD 1.01.003	Equipment Documentation Requirements (Rev. B)			
CDC-STD 1.10.010	Terminology for Referencing American National Standards (Rev. A)			
CDC-STD 1.10.012	Vocabulary for Information Processing (Rev. A)			
CDC-STD 1.41.101	Graphic Symbols for Electrical and Electronic Diagrams (Rev. A)			
CDC-STD 1.41.102	Reference Designations for Electrical and Electronic Parts and Equipment (Rev. B)			
CDC-STD 1.41.104	Graphic Symbols for Logic Diagrams (Rev. B)			
CDC-STD 1.50.001	Product Support Manuals (Rev. B)	X	X	
CDC-STD 1.50.003	Flowchart Symbols and Usage (Rev. A)			
CDC-STD 1.53.002	Software Development Documentation (Rev. A)	X	X	
CDC-STD 1.53.003	Internal Maintenance Specification (Rev. A)	X	X	
CDC-STD 1.53.004	External Reference Specification (Rev. A)	X	X	
CDC-STD 1.5006100	Microcircuit Handbook			